Acoustic Emission Monitoring during the Drift Scale Test at Yucca Mountain, Nevada

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RESEARCH OBJECTIVES

The Drift Scale Test (DST) is part of the Exploratory Studies Facility (ESF) Thermal Test being conducted underground at the potential high-level nuclear waste repository at Yucca Mountain, Nevada. The purpose of the ESF Thermal Test is to acquire a more in-depth understanding of the coupled thermal, hydrological and chemical processes likely to be encountered in the rock mass surrounding the potential repository. The purpose of the acoustic emission monitoring effort is to quantify and infer changes in rock properties of the material surrounding the drift as the temperature increases. As rock is heated in a confined underground environment, thermal expansion may cause cracking of the rock mass or movement along any pre-existing fractures or joints. Seismic methods have been shown to assist in resolving such alterations.

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APPROACH

In this work, acoustic emission activity is registered by using 14 accelerometers emplaced radially around the heater drift. Acoustic emission activity is analyzed both spatially and temporally. The location and timing of such changes in activity are expected to correspond to those areas encompassing the thermal testing where physical change or disturbance in the rock mass is occurring. Such areas are to be compared with the results from other tests conducted in support of the DST. Installation of the recording system occurred on Nov. 15, 1997, one month before heating was initiated. The system was initially plagued with noise problems, which deluged the system with false triggers. These problems were solved and the system has been working continuously since January 1999.

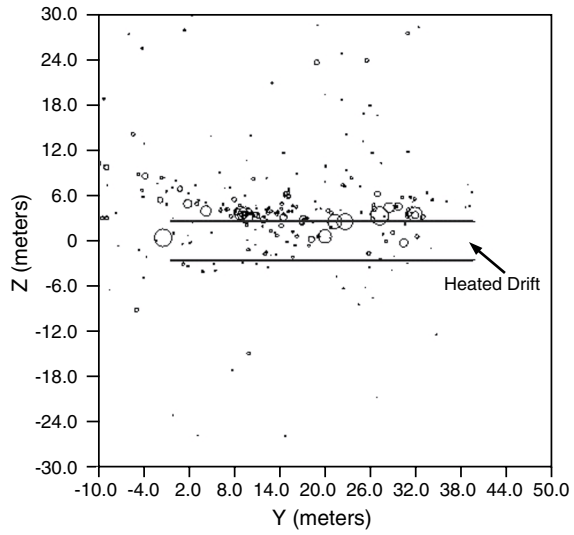

Figure 1. Locations of all microseismic events occuring between January 1, 1999, and April 6, 2000.

ACCOMPLISHMENTS

From January 1999 to April 2000, a total of 300 acoustic emission events have been analyzed and located. The microseismic activity appears to have dramatically increased after July 1999, from about five events per month to about 30 events per month for July and September (the system was down in August 1999), and 50 events per month until February 2000. The March 2000 and April 2000 data indicate a decrease in activity back to 5-10 events per month. Some of this activity may be related to the Hector Mine earthquake of October 1999. However, the increase in activity began more than a month before this earthquake occurred.

The microseismic activity appears to be clustered within a few meters above the Heater Drift. Figure 1 shows the location of the events as circles, with the size of the circle indicating the magnitude relative to the magnitude of a sledgehammer hit to the side of the drift. The largest cluster of events occurred at about Y = 9 to 10 m. The area above the tunnel is naturally under stress due to geometry of the tunnel itself. It is also the area which may have the largest change in saturation due to increased temperature and draining of fractures and voids. The location of the acoustic emission events also agrees with measurements of mechanical displacement, which indicate larger displacements occurring at the top of the tunnel.

SIGNIFICANCE OF FINDINGS

Acoustic emissions provide spatial and temporal information about stress changes due to temperature increases. This work has provided data suggesting that the increase in temperature has a significant effect on the rock, especially above the drift.

ACKNOWLEDGEMENTS

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